

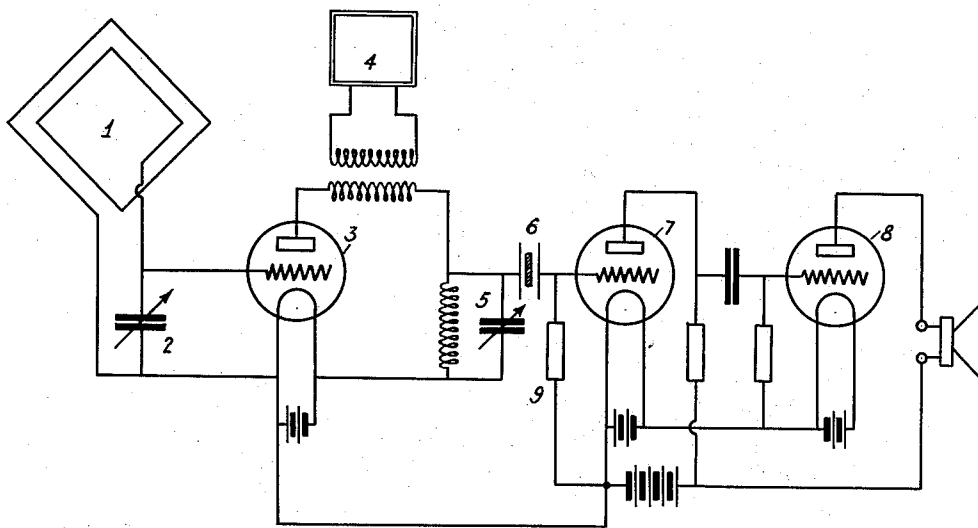
Jan. 7, 1930.

S. LOEWE

1,742,773

RADIO SIGNALING SYSTEM

Filed Jan. 5, 1928



INVENTOR
SIEGMUND LOEWE
BY *Max J. Adams*
ATTORNEY

UNITED STATES PATENT OFFICE

SIEGMUND LOEWE, OF BERLIN, GERMANY, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

RADIO SIGNALING SYSTEM

Application filed January 5, 1928, Serial No. 244,828, and in Germany December 18, 1926.

An application for patent for this invention has been filed in Germany on December 18, 1926.

This invention relates to a radio signaling system and especially to an improved radio receiving circuit.

Efficient receiver apparatus is required to combine high selectivity, high sensitiveness and simplicity in operation and manipulation. A number of receiver principles are in actual use which more or less measure up to these requirements. While it is comparatively easy to insure high sensitivity in receiver apparatus, the requirement of insuring simultaneous high selectivity and simplicity in operation and construction militate against each other in so far as high selectivity according to the present state of the art is concerned. At present high selectivity may be obtained only by the provision of a number of filter circuits which are tuned either to the incoming wave or to intermediate frequencies produced by the superposition of locally produced waves. But the selective action, on the other hand, should not be pushed to a point where the passed frequency band becomes unduly narrow, for in such case the characteristic overtones of the transmitted speech or music are eliminated, and this results in a greatly impaired quality of reproduction.

The object of this invention is to provide a radio receiving system having extremely high selectivity and yet allowing of audio reproduction of high quality. This I accomplish by utilizing a piezo-electric crystal and intermediate frequency energy of a frequency higher than the incoming wave so that the side bands utilized will vary but a few percent from the intermediate frequency and thereby not be eliminated by the use of the crystal.

Fundamentally speaking, the well-known quartz crystal resonators would be highly suited for the purpose of increasing the selective action of receiver apparatus, but the damping of the same is so low that the in-

convenience of side band elimination would arise in as much as the resultant frequency band that is passed by the crystal is unduly narrow for good reproduction.

However, this disadvantage will play a much less serious part, the shorter the length of the working wave, contradistinct from what holds good for operation on waves of, say, 1000 meters in length where serious impairment of speech transmission will arise. If selection is effected by means of a quartz crystal resonator tuned to 1000 meters good reproduction is had as soon as wave-lengths below 200 meters are used, while it becomes excellent for waves less than 150 meters. This is due to the natural damping conditions of quartz crystals, and to the fact that, the lighter the frequency, or, in other words, the less the length of the wave, the smaller (expressed in terms of percent) will be the frequency change caused by the superposed speech or music. This fact is utilized according to the disclosures of the present invention in the following way.

While in known transposition arrangements, it is usually the differential frequency between the incoming and the local waves that is used as the intermediate frequency (a frequency that is far lower than either of the two components), it is the integrated frequency which is employed according to my invention. This integral frequency is substantially higher than that of its components. Under usual conditions the integral frequency corresponds to a wave-length below 150 meters. Hence, this is a very fruitful field of application for a combination of only moderately selective circuit arrangements and quartz crystals, for it is then possible to utilize the extremely high selection properties of quartz crystals without losing the amplification of the side-band frequencies. While the quartz crystal is depended upon for selection, the remainder of the apparatus may be made moderately selective, in other

words, resistance-coupled radio frequency, integral frequency and audio frequency amplifiers may be employed, preferably in the shape of the known resistance-capacity-coupled multiple-unit tubes.

A circuit arrangement embodying the fundamental idea of my invention hereinbefore outlined is shown by way of example in the accompanying drawing. The incoming energy, picked up by the loop antenna 1 comprising tuning condenser 2, is fed to the tube 3. 4 denotes the local oscillator or heterodyne. The circuit 5 is tuned to the integrated frequency; transfer of energy to the subsequent integrated frequency and audio frequency systems is effected by the agency of the quartz resonator 6 which is likewise tuned to the integral frequency. The said resonator acts with regard to all frequencies deviating from its natural period like an extremely high capacitive impedance while its impedance is extremely low for the resonance frequency of the quartz crystal. Hence, the energy transfer to the subsequent amplifier stages is effective substantially only for the said frequency, the said subsequent stages being indicated at 7 and 8 representing resistance-capacity-coupled tubes. To prevent charging of the grid of tube 7, the grid may be provided with resistance 9 to afford a leak to the cathode or to a potentiometer for the purpose of suitable selection of biasing potential.

I claim as my invention:

1. In a receiver circuit, an antenna for collecting radiated energy, an electronic discharge device, said antenna being coupled to the input of said device, means for impressing locally generated high frequency oscillations on the output circuit of said device, amplifier and rectifier means, a resonant circuit in said output circuit tuned to the integrated frequency made up of incoming and locally generated oscillations, and a coupling means between the resonant circuit and said amplifier and rectifier means comprising a piezo-electric means having a resonant frequency equal to that of said integrated frequency.
2. A heterodyne receiver circuit comprising an electronic discharge device having an input and output circuit, an antenna coupled to said input circuit, a source of local oscillations coupled to said output circuit, a resonant circuit tuned to the integrated frequency of the incoming and locally generated waves in said output circuit with said last mentioned coupling means, an amplifier tube, and a piezo-electric crystal coupling said resonant circuit and said amplifier tube, said crystal having a natural period of vibration equal to said integrated frequency.
3. For a receiver circuit, means for collecting desired signal energy, frequency changing means, including an electron discharge

tube, coupled to said collecting means, means for impressing locally generated high frequency oscillations upon said frequency changing means, subsequent means for amplifying and detecting frequencies equal to the sum of the signal and local frequencies, and means resonant to the sum frequencies for coupling the frequency changing means and subsequent means, said coupling means including a piezo-electric means having a resonant frequency equal to that of the said sum frequency.

SIEGMUND LOEWE.

70

75

80

85

90

95

100

105

110

115

120

125

130